2 HISTORICAL ROLE OF PALMS IN HUMAN CULTURE

Pre-industrial indigenous people of the past as well as of the present have an intimate and direct relationship with the renewable natural resources of their environment. Prior to the Industrial Age, wild and cultivated plants and wild and domesticated animals provided all of the food and most of the material needs of particular groups of people. Looking back to those past times it is apparent that a few plant families played a prominent role as a source of edible and nonedible raw materials. For the entire world, three plant families stand out in terms of their past and present utility to humankind: the grass family (Gramineae), the legume family (Leguminosae) and the palm family (Palmae). If the geographic focus is narrowed to the tropical regions, the importance of the palm family is obvious.

The following discussion sets out to provide an overview of the economic importance of palms in earlier times. No single comprehensive study has yet been made of the historical role of palms in human culture, making this effort more difficult. A considerable amount of information on the subject is scattered in the anthropological and sociological literature as part of ethnographic treatments of culture groups throughout the tropics. Moreover, historical uses of products from individual palm species can be found in studies of major economic species such as the coconut or date palms. It should also be noted that in addition to being highly utilitarian, palms have a pivotal role in myth and ritual in certain cultures.

Three different but complementary approaches are taken to elucidate the historical role of palms in human culture. An initial approach is to look at ancient and traditional palm products, which deals mostly but not exclusively with subsistence palm uses. Next, case studies of indigenous groups and their particular array of palm uses are presented. Finally, the subject of palm domestication is addressed.

Ancient and Traditional Palm Products

The assortment of products that have been derived from palms at some time or another is indeed impressive. Although now somewhat dated, one of the best and concise summaries of palm usage can be found in Dahlgren (1944). Balick and Beck2[2] (1990), in their excellent bibliography, compiled a list of 388 keywords to describe palm products. The bibliography editors broke down these many products into a dozen major classes, as follows: beverages; building materials; chemicals and industrial products; cosmetics and hygiene; feeds; fertilizers; food; fuel; handicrafts; medicines and rituals; ornamental plants; and structure and shelter. Handicrafts represent the largest class with 162 products and is divided into nine subclasses.

As a means of demonstrating some of the oldest human palm uses, the foregoing product classes are followed and one or more individual examples cited within each class, except in the instance of handicrafts where subclasses are included. It is not the intention here to describe in detail the processing of particular palm products, but instead to give a historical perspective through examples that will aid in better understanding the current situation and the potential for palm product development, subjects to be dealt with in future chapters of this report. In choosing the examples presented below, preference was given, whenever possible,

[2] Useful Palms of the World: A Synoptic Bibliography, represents the most comprehensive single source of information on palm utilization. It provides abstracts of 1,039 publications.

to traditional products directly used by local populations. Selected bibliographic references are provided.

Beverages. Palm wine or toddy is an ancient beverage derived from the sap of a number of different palm species, and serves as an appropriate example of a beverage. The sap is obtained by tapping and collecting the liquid in a receptacle from the inflorescence of the tree employing sophisticated techniques that must have required considerable trial-and-error experimentation. Tapping the stem or felling the tree is also a means of obtaining sap that are much simpler. There is no difference in the quality of the sap obtained from the different methods. Because of the presence of naturally-occurring yeast, the sweet palm sap ferments within hours into a mild alcoholic beverage.

Palm tapping for beverage purposes is a pantropical practice, but has its greatest historical depth in Asia and Africa. In Asia, several palm species are traditional sources of palm wine; among them are the coconut (*Cocos nucifera*), the palmyra (*Borassus flabellifer*), the wild date (*Phoenix sylvestris*) and nipa (*Nypa fruticans*). Hamilton and Murphy (1988) describe tapping of nipa palm in Southeast Asia. The African continent has a long tradition of palm wine production, for example from the African oil palm (*Elaeis guineensis*), the doum palms (*Hyphaene* spp), and the raffia palms (*Raphia* spp.), as well as the Senegal date palm (*Phoenix reclinata*). Essiamah (1992) provides a description of palm wine production in West Africa from the African oil palm; Cunningham (1990a,b) reports on the tapping of *Hyphaene coriacea* and *Phoenix reclinata* in southeastern Africa. Tapping palms for the production of palm wine in Latin America and the Caribbean also has a long history, but the practice is uncommon today. Two examples of wine palms in South America are the moriche palm (*Mauritia flexuosa*) (Gumilla, 1963) and the Chilean wine palm (*Jubaea chilensis*) (Grau, 2006).

Building Materials. Within this class of products is one of the oldest and most ubiquitous palm products of all: thatch. Palm thatch is widely used for temporary and more permanent structures. The leaves of virtually all palms can be used for thatch, whether they are pinnate, palmate or entire in shape. This palm use is so widespread that there is almost no need to give examples of particular geographic areas or palm species. Bomhard (1964) provides a good summary of the various ways palms are utilized in building houses. An annotated bibliography of palm leaf and stem use was compiled by Killmann *et al*. (1989). Leaf sheath fiber may also be used for thatch. *Arenga pinnata*, for example, is a source of very durable thatch of this type, lasting 50 years or more (J. Dransfield, pers. com.)

Utilizing palm thatch is simple. Leaves are cut from the palm, generally selecting leaves that are younger and more flexible. Transported to the construction site, the leaves are attached individually to a roof frame in an overlapping fashion beginning at the lowest point. When a palm is exploited that has small leaves, the leaves may be attached to a stick in the form of a panel before being affixed to the roof. The small understory Amazonian palm *Lepidocaryum tenue* is used in this manner. A palm-thatched roof is light-weight and, if tightly made, remarkably waterproof. But at the same time it is porous, allowing air movement and the escape of cooking-fire smoke. A roof will last for a few years, the length of time depending upon the local climate and the type of palm leaf used.

Chemicals and Industrial Products. Clearly this class of products is modern. Nevertheless an original traditional palm product can be mentioned. Dragon's blood is the common name for the red resinous exudation which occurs on the scales of fruits of the Southeast Asian

rattans *Daemonorops didymophylla, D. draco* and related species. (The original source of dragon's blood was Dracaena spp. in the Ruscaceae family). This resinous substance was a dye source for coloring cloth, woven mats and the like among indigenous peoples and in the 19th Century was adopted for industrial use in Europe as both a varnish and dye. In the traditional medicine of Southeast Asia, dragon's blood was used to treat stomach ailments, a use carried over into European medicine for a time (Burkill, 1966). Apparently dragon's blood continues to be of industrial use as a resin and is commercially available (Merlini and Nasini, 1976). Its therapeutic uses were studied by Gupta *et al*. (2008).

Cosmetics and Hygiene. Palm oils in general have a wide variety of household and industrial uses (see Hodge, 1975). An example within this product class can be cited from Madagascar where mesocarp oil of the raffia palm (*Raphia farinifera*) has been employed as a traditional hairdressing (Sadebeck, 1899).

Feeds. Cattle can be fed fresh young palm leaves if there is a shortage of better forage, as occurs in tropical areas subject to a protracted dry season. Leaves are cut and brought to the cattle and may or may not be chopped into smaller pieces to make them easier to consume. If the palms are of low enough stature, cattle and other livestock may forage on them directly. In Paraguay, leaves of the mbocaya palm (*Acrocomia aculeata*) provide forage (Markley, 1953). Palm fruits in general are eaten by swine.

Fertilizer. Traditional palm exploitation indirectly produces quantities of organic matter such as waste fruit parts, leaves and stalks suitable for incorporation into garden soil as fertilizer.
Food. This class of palm products represents the most important in economic terms since it includes the vegetable oils. Best known are the coconut (Cocos nucifera) and the African oil palm (Elaeis guineensis), both now commercially cultivated as sources of oil throughout the tropical realm. In addition, there are a number of Neotropical oil palms of lesser importance (see Balick, 1979a).

There are two types of oil derived from the palm fruit: mesocarp oil and endosperm (kernel) oil. Both types have a long history of pre-industrial utilization for culinary and other purposes throughout the tropics. The African oil palm is a good example because it is a source of both oil types; the mesocarp and the kernel each contain about 50 percent oil. In this palm, oil can be extracted from the fleshy mesocarp most easily. Fruits are fermented for a few days, pounded to remove the pulp which is boiled in water and the oil skimmed off. Mesocarp oil remains liquid at ambient temperatures in the tropics. Extraction of kernel oil requires crushing the kernels and mechanically pressing the resultant cake to express the oil.

Some lesser-known palm food items include: 1) eating young male inflorescences of the Central American pacaya palm (*Chamaedorea tepejilote*), Castillo Mont *et al*. (1994); 2) salt (potassium chloride) derived from burning palm leaves (Karlansky, 2002); 3) purple pollen from male flowers of *Eugeissona utilis*, used by the Penan of Borneo as a condiment (Kiew, 1977); 4) makapuno, a special type of coconut which has its shell filled with a soft, jelly-like endosperm, rather than coconut water and coconut meat. Makapuno endosperm has a unique flavor and in the Philippines is esteemed for use in sweet dishes and even ice cream (Ohler, 1984).

In recent years, the positive role of antioxidants (e.g. vitamins C and E) in human health has prompted reassessment of fresh fruits as dietary sources. Fruit of the açaí palm (*Euterpe oleracea*) of Brazil was found to be extraordinarily rich in antioxidants (Schauss, 2006). Açaí

juice, as a result, has become a new product on the United States market. There are other fleshy palm fruits known to be rich in antioxidants including date palm (Rock *et al*., 2009), peach palm (*Bactris gasipaes var. gasipaes*) (Jatunov *et al*., 2009) and salak (*Salacca zalacca*) (Aralas *et* al., 2009). These new developments provide opportunities for promoting palm fruit commercialization.

Fuel. The simplest fuel usages of palms are exemplified by the burning of dry palm leaves, petioles, stem wood and fruit husks of some species such as the coconut. Often such fuels represent using by-products of the extraction of some other palm product. This palm use is ubiquitous.

Handicrafts. This class of palm products is exceedingly large and for that reason has been subdivided into nine subclasses.

Agricultural Implements. Climbing loops are traditional devices often made from palm leaf fiber, midribs or petioles. They are employed as an aid in climbing palms to harvest fruit, leaves or to tap the tree for sap; loops are, of course, used to climb trees other than palms for similar purposes. There are a number of different styles of climbing loops across the tropics. A type employed in West Africa is made from the petiole and leaf fiber of the African oil palm. It encircles both the tree trunk and the climber, permitting him to have his hands free to tap, in many cases, the same palm species which has provided materials for the climbing loop.

Clothing. The classic example of this palm use is a hat made from palm leaf material, a use found throughout the tropics. Young pinnate and palmate leaves of virtually any palm species serves for hat making. The weave may be coarse or fine depending upon how thin the leaflets are stripped and the amount of time invested by the artisan. Leaf fiber can also be woven into cloth and made into clothing. **Raphia** fiber is used extensively for this purpose in Madagascar even today (J. Dransfield, pers. com).

Furniture. Hammocks represent an article of furniture often made from fiber extracted from young palm leaves. In South America, the pinnate-leaf chambira palm (*Astrocaryum chambira*) is the preferred palm fiber source (Wheeler, 1970). The fiber is made into string and then woven into an open mesh hammock. The word *hammock* is Amerindian in origin and the weaving and use of hammocks appears to be restricted to the Neotropics as an ancient practice.

Coconut wood has many uses, including making furniture and building products (Weldy, 2002).

Games and Toys. A variety of simple objects for children to play with in the tropics are fashioned from palm leaves and petioles. Certain games involve palm products. In Southeast Asia, for example, hollow balls made of wound rattan strips are kicked in a game played by children and adults. Historically, in Sri Lanka, a variety of coconut was cultivated with an exceptionally thick shell (endocarp) for a game called "fighting coconuts." The game involves two competitors each clutching one of these special coconuts. The contest entails striking the coconuts together until one breaks, the holder of the intact nut being the winner.

Household Items. Sieves represent examples of ubiquitous household items made from palm fiber throughout the tropical regions. Thin strips of leaflets are woven in a square or diagonal

pattern to produce a rectangular or round sieve. Wood sticks are often incorporated into the edge to prevent fraying and make the sieve easier to handle.

Jewelry. Among many cultural groups in the tropics necklaces traditionally are made by stringing small palm seeds. The hard endosperm of the Caroline ivory nut palm (*Metroxylon amicarum*), native to the Caroline Islands in the Pacific Ocean, is carved into beads and buttons. In Tropical America the tagua palm (*Phytelephas macrocarpa*) bears seeds with a hard endosperm which is fashioned into jewelry and other decorative objects; it is often referred to as "vegetable ivory."

A mythical palm product is appropriate to this heading: coconut pearls. Alleged to have been found inside coconuts, they have been touted for their rarity and even displayed in museums. However, despite a number of historical references to coconut pearls, no modern reports exist to support their validity. Analysis of some so-called coconut pearls has revealed that they are composed of calcium carbonate, which does not occur in any appreciable quantity in the coconut fruit (Child, 1974; Ohler, 1984).

Musical Instruments. In addition to the use of palm fiber to make strings for musical instruments, drums can be made from hollowed-out palm stems. The palmyra palm (*Borassus flabellifer*) has reportedly been used for this latter purpose in parts of Asia.

Stationery and Books. Palm leaves were an ancient writing material in India, perhaps as old as written language itself. Segments of the palmate leaves of the talipot palm (*Corypha umbraculifera*), as well as some other palms, were written upon with a metal stylus. Examples of these palm leaf manuscripts are preserved in museums.

Weapons and Hunting Tools. Palm wood is widely used for this purpose. For example, indigenous people in the Philippines utilize the hard outer wood of the palms in the genus Livistona to make bows and spear shafts (Brown and Merrill, 1919).

Medicines and Ritual. Throughout their range palms are sources of folk medicines and are a part of rituals. Dragon's blood resin (see above) is burned as incense in witchcraft rituals in the United States and is sold in shops specializing in products associated with witchcraft and magic.

An example combining medicinal and ritual use is found in the betel nut palm (*Areca catechu*). Large numbers of people in Asia and Polynesia have for millennia chewed betel seeds mixed with fresh betel pepper leaf and a bit of slaked lime; it is the classic Asian masticatory. The betel nut contains an alkaloid that is mildly narcotic (see Table 9-1).

Ornamental Use. Flowers are universally used as decorations for many types of rites and ceremonies. In the tropics, branches of palm inflorescences are often employed. Sprigs of coconut flowers, for example, are used in India and Sri Lanka for wedding decorations. Leaves of wild *Chamaedorea* palms in Mexico and Central America are collected, exported and sold for cut foliage in floral arrangements (see Table 6-1).

Palm leaves have a traditional role in the three major world religions. For example, white date palm leaves are produced commercially in Elche, Spain and Bordighera, Italy, especially for use in ceremonies during Holy Week in the Christian world. Leaves are prepared by wrapping new leaves to protect them from light; the result after about one year is a fully

developed pale nearly white leaf. White leaves are sold within Spain and Italy and exported to other countries (Gómez and Ferry, 1999).

Structure and Shelter. This is another huge class of palm products. A couple of the less common uses are the rigging of sailing vessels with thin rattans rather than rope in Indonesia, and the use of entire stems of the caranday palm (*Copernicia alba*) as utility poles in Paraguay. Hollowed out palm stems have a variety of uses. Small diameter stems can serve as blow guns and water pipes; the swollen portion of some large diameter palms have been used to make canoes (Johnson and Mejia, 1998) and even coffins.

The product classes employed in this section portray the great variety of palm products, past and present, and cover every aspect of material culture. But that does not explain everything about palms and human culture. Apart from their value as a source of useful products, palms are also of general interest simply because of their beauty and symmetry, which may help to explain the role of palms in religion and folklore.

Case Studies: Indigenous Groups and Their Use of Palms

Shifting away from a product approach to a focus on specific indigenous groups and their utilization of palms provides another dimension to this discussion. For this purpose, accounts of palm use have been taken from studies in Asia, the Pacific, Africa and Latin America. Criteria for selection of the case studies were as follows: focus on a particular indigenous group, local as well as scientific names of the utilized palms were known and palm use was described in some detail. Moreover, an attempt was made to have the case studies represent widely separated geographic regions and a diversity of local palm species diversity. The four case studies chosen describe the Iban of Sarawak, the Shipibo of Amazonian Peru, the Kwanyama Ovambo of Namibia and the Trukese of the Caroline Islands of Micronesia in the Pacific. The grammatical present tense is used in this section to refer to both past and present palm uses.

The Iban

This first case study focuses on the Iban, an indigenous group in southwestern Sarawak, East Malaysia. The Iban inhabit an area of largely undisturbed natural forest, with heavy rainfall, varied terrain and an attitudinal range of sea level to 760 m. Kubah National Park occupies about 2,230 ha in the area. Pearce (1994) studied the palms of the park and its immediate environs and gathered excellent data on the identity of the palms as well as their utilization by the Iban people. Pearce relied on earlier systematic studies by J. Dransfield, when she did field work in 1990. Southwestern Sarawak is considered to have one of the richest palm floras in the world, as evidenced by the cataloging of 99 palms in and around the park.

The 47 native palms used by the Iban are listed in Table 2-1. The predominance of the rattan palm genera (*Calamus, Daemonorops, Korthalsia, Plectocomia* and *Plectocomiopsis*) is striking as they together account for 31 of the 47 palms.

Table 2-1 Iban, Sarawak, Malaysia, Utilization of Native Palms

Scientific Name/Iban Name	**Uses**
Arenga hastata, mudor	down on stem as tinder
Calamus blumei, wi kijang	baskets
Calamus caesius, sega	many uses, the best split rattan
Calamus conirostris, rotan	basket spars and weaving; general uses
Calamus corrugatus, wijanggut	many uses, as good as *Calamus caesius*; smallest diameter of local cane
Calamus crassifolius, witakong	binding basket edges and parangs (bush knives); sewing atap (thatch)
Calamus flabellatus, wi takung	baskets; various other uses
Calamus gonospermus, sega ai	baskets, split or whole
Calamus hispidulus, rotan	cane can be used
Calamus javensis, wi anak	baskets, split or whole
Calamus laevigatus var. *laevigatus*, rotan lio	baskets, mats, tying
Calamus laevigatus var. *mucronatus*, rotan	good cane
Calamus marginatus, wi matahari	sold as *Calamus caesius*
Calamus mattanensis, rotan lemba	baskets; many other uses
Calamus muricatus, rotan putch	baskets, rough temporary; tying; good split or whole
Calamus nematospadix, rotan tunggal	baskets; various other uses; sewing atap (split)
Calamus paspalanthus, rotan tingkas	edible palm heart, sour fruit; cane
Calamus pilosellus, rotan anak	binding
Caryota mitis, mudor	edible palm heart; stem down for tinder

Scientific Name/Iban Name	**Uses**
Ceratolobus discolor, danan	basket spars, weaving
Ceratolobus subangulatus, rotan janggut	baskets, tying, etc.
Daemonorops acamptostachys, rotan duduk	fishing baskets from petiole skin
Daemonorops cristata, wi getah	fruit exudate as gum; fruit eaten by children
Daemonorops didymophylla, wi getah, rotan jernang	baskets, especially earth baskets; sarcotesta sweet and juicy
Daemonorops fissa (none)	basket spars, weaving; fruit slightly sweet, edible; palm heart edible, sold locally
Daemonorops periacantha, wi empunok	basket edges, mats, chairs; palm heart and fruit edible
Daemonorops sabut, wi lepoh	basket spars, weaving
Eugeissona insignis, pantu kejatau	petiole pith for dart plugs, petiole skin for baskets; palm heart and young fruit edible
Korthalsia cheb, danan semut	furniture and general utility
Korthalsia echinometra, wi seru	cane used
Korthalsia ferox, danan kuning	baskets, furniture, many other uses.
Korthalsia flagellaris, danan	baskets, weaving, many other uses
Korthalsia rigida, danan tai manok	baskets, chairs, various other uses
Korthalsia rostrata, danan wi batu	baskets, chicken coops; sewing (split); tying logs
Licuala bintulensis, biru	leaflets for hats, wrapping; petiole skin for weaving winnowing baskets
Licuala orbicularis, biru bulat	leaves for wrapping, making hats, umbrellas and atap
Licuala petiolulata, gerenis	petiole skin for making baskets

Scientific Name/Iban Name	Uses
Licuala valida, pala	petiole skin for winnowing baskets; leaflets for wrapping; palm heart edible
Oncosperma horridum, nibong	bark for floors and walls; palm heart edible
Pinanga cf. *ligulata*, pinang	stem for lance shaft
Pinanga mooreana, pinang murind	walking sticks; fruit eaten
Plectocomia mulleri, rotan tibu	baskets, chairs, etc; good split
Plectocomiopsis nov. sp., belibih	many uses; very useful because nodes are flat
Salacca affinis, ridan	petiole for fishing rods; petiole skin for baskets; leaves for camp shelters; fruit edible
Salacca vermicularis, lamayung	petiole skin for weaving baskets; fruit edible
Salacca nov. sp., lekam	fruit (sweet-sour) edible

Source: Pearce, 1994.

The Shipibo

The Shipibo of Peru serve as a second case study. These Amerindian people occupy tropical lowland forest land on the central Ucayali River, a tributary of the Amazon, near the Peruvian city of Pucallpa. Bodley and Benson (1979) made a detailed study of the Shipibo which focused on the utilization of palms in everyday life. Field research was carried out in 1976-1977. In vegetation surveys, the authors found within the Shipibo reserve and adjoining areas a rich palm flora of at least 24 species. Data were collected on the contemporary utilization of palms and products identified to their species of origin. Table 2-2 lists 19 different local palms utilized by the Shipibo.

As Table 2-2 shows, considerable use is made of palms for building materials, food and handicrafts. It is interesting to note that the Shipibo have taken their tradition of making bows and arrows from palm wood and turned it into crafting souvenirs to sell to tourists visiting the area.

Table 2-2 Shipibo, Peru, Utilization of Native Palms

Scientific and Shipibo Common Names	**Uses**
Astrocaryum huicungo[*], páni	new pinnate leaves to make women's spinning basket; stems as house posts
Astrocaryum jauari, yahuarhuanqui	stems as house posts; petioles to make burden baskets; ripe fruit as fish bait
Attalea bassleriana[*], cansín, shebón	pinnate leaves for thatch; new leaves to make sitting mats, small baskets; leaf pinnae to make brooms; edible fruit
Attalea tessmannii, conta	leaf pinnae to make brooms
Bactris concinna, shiní	edible fruit
Bactris gasipaes var. *gasipaes*, juani	cultivated for edible fruit; stem wood made into bows, arrow points, lances, awls, clubs, spindles, loom parts
Bactris maraja, taná	edible fruit; stems as house floor supports, rafters
Chelyocarpus ulei, bonká	palmate leaves as sitting mats, umbrellas, bush meat wrapper
Euterpe precatoria, paná	stems as house posts; stem slats as house walls; edible palm heart; fruit mesocarp oil as women's hair dressing
Geonoma deversa, quebón juani	stems to support mosquito nets
Iriartea deltoidea[*], tao	stem wood for house flooring, shelving, rafters, support beams, harpoon staves, arrow points, roof ridge pins; swollen stem for temporary canoe
Mauritia flexuosa, vinon	edible fruit; petioles for loom parts; split petioles woven into sitting mats
Maximiliana venatorum (unplaced name), canis	split petioles woven into sleeping mats; spathe made into hanging storage basket
Oenocarpus bataua var. *bataua*[*], isá	edible fruit; leaf pinnae made into brooms
Oenocarpus mapora[*], jephue isá	stem wood for bows and arrows sold to tourists; edible fruits; stems as house posts
Phytelephas macrocarpa[*], jephue	pinnate leaves for roof thatch; petiole made into tray-like storage basket; edible immature fruit endosperm

Scientific and Shipibo Common Names	Uses
Socratea exorrhiza, sino	stem wood for flooring, bows and arrow for tourists; spiny roots as graters
Syagrus sancona, shuhui	stem wood for loom parts

Note: * Binomials changed to currently accepted names.
Source: Bodley & Benson, 1979.

The Kwanyama Ovambo

Case study three is from Africa where palm species diversity is low, but palm populations often significant; in such cases palm utilization may be high and varied, but focused on a few species.

The Kwanyama live in Ovamboland which lies in north-central Namibia bordering Angola to the north. The latitude is approximately 17.5O south, elevations average about 1,000 m and annual rainfall is 520 mm. Namibia has only two native palms. The most prevalent is the African ivory nut palm, common name omulunga, *Hyphaene petersiana* ; this species of *Hyphaene* is single-stemmed and does not branch. The second palm is the Senegal date palm, vernacular name omulunga wangolo, *Phoenix reclinata*.

Rodin (1985) published a detailed ethnobotanical study of the Kwanyama based upon field work in 1947 and 1973. More recently, Konstant *et al*. (1995) and Sullivan *et al*. (1995) studied exploitation of *Hyphaene petersiana* in the same general area. Table 2-3 summarizes palm utilization based on these references.

Table 2-3 Kwanyama Ovambo, Namibia, Utilization of Native Palms

Palm Product Classes*	Uses of African ivory nut palm, *Hyphaene petersiana*, except as noted
beverages	palm wine by fermenting mesocarp pulp and from sap by tapping flower bud; palm wine distilled into spirits
building materials	leaves for thatch; leaf fiber made into rope; petioles for hut construction, fencing
chemicals and industrial products	vegetable ivory (hard endosperm) carved into buttons, ornamental objects
cosmetics and hygiene	shredded leaves dyed for wigs
feeds	cattle, goats and donkeys rely on palms for fodder
fertilizer	likely, but not specifically stated in references cited

Palm Product Classes*	**Uses of African ivory nut palm, *Hyphaene petersiana*, except as noted**
food	edible palm heart, raw fibrous fruit mesocarp; fruits of *Phoenix reclinata* eaten fresh or preserved by drying
fuel	petioles, flower stalks for cooking fires
handicrafts (all types)	leaves used to weave baskets, mats, hats; petioles made into hunting bows, carrying poles, stirring spoons; leaflets woven into special beer strainer; fused twin seeds as children's' dolls
medicines and ritual	leaves used to shape headdresses and bridal hats; skirts, necklaces and bracelets braided from leaf blades during female puberty rites
ornamental use	shade tree, likely, but not specifically stated in references cited
structure and shelter	stems hollowed out for cattle water troughs

Note: * After Balick & Beck, 1990.
Sources: Rodin, 1985; Konstant *et al*., 1995; Sullivan *et al*., 1995.

Palm use is recorded within each of 12 product classes developed by Balick and Beck (1990), and all originate from the African ivory nut palm, except for limited food use of the fruits of the Senegal date palm, a rare tree in the area. No medicinal use of this palm is reported despite its intensive exploitation and the fact that other species of *Hyphaene* play a role in medicine. Rodin (1985) asserts that the ivory nut palm is the most useful of all the native plants in Ovamboland; he further states that it is illegal to cut down the palm because of its exceptional value to the local people.

The Trukese

The final case study is from the Pacific Ocean region. Geographically Truk designates a group of islands which form a part of the Caroline Islands, which are located about 680 miles southeast of Guam. The inhabitants, the Trukese, are Micronesians.

Despite its equatorial latitude, Truk has very poor palm species diversity. According to Moore and Fosberg (1956), only three species of palms occur naturally in the Truk Islands; namely *Clinostigma carolinensis*, an endemic palm under threat of extinction, the Caroline ivory nut palm, "os" in the local language, (*Metroxylon amicarum*) and the nipa palm (*Nypa fruticans*). The coconut palm, locally-called "ny," (*Cocos nucifera*) is naturalized and widely cultivated on Truk. Other reported introduced species in the islands are the betel nut palm (*Areca catechu*) and the African oil palm (*Elaeis guineensis*).

LeBar (1964) conducted a study of the material culture of Truk which revealed the extent to which the local people make use of floral resources to provide their needs. Field research was done in 1947-1948. Using the categories in LeBar's study, information on palm use was excerpted and is presented in Table 2-4.

Table 2-4 documents the utilization of only the coconut and ivory nut palms, but the diversity of coconut palm use, with examples in every material culture category, is impressive. The significance of the coconut palm among the Trukese may have been enhanced during the years of Japanese control of the islands (1914-1945) when coconut growing for copra production was encouraged. The absence of hat making from palm leaves is because of the presence and use of pandanus for that purpose.

The four preceding case studies demonstrate how very important palms are, for subsistence and commercial purposes, to indigenous peoples throughout the tropics. Most revealing about the case studies is that palm utilization is equally intense in areas of high and low palm species diversity. A major difference appears to be that local people have a choice of different palms to exploit for the same end use where high palm species diversity occurs; for example, leaves for thatching or weaving.

Table 2-4 Trukese, Caroline Islands, Pacific Ocean, Utilization of Palms

Material Culture Category	**Uses of coconut *(Cocos nucifera),* except as noted**
tools and utensils	fiber cord as polisher; leaflet midrib made into needle; shell flask made with coconut fiber handle; dry husks or old palm leaf basket as cushion; leaf sheath fiber to hold grated coconut meat to be pressed; fiber cord made into tree climbing loops
Cordage	coir fiber for cordage
plaiting	leaflet plaited into mats: single wall mat, double wall mat, canoe mat; leaflet baskets: temporary field basket, semipermanent field basket, woman's fish basket, woman's weaving basket; leaflet fans; cord baskets
weaving	ivory nut palm midrib to make loom parts; coconut fiber sling for loom
chemical industries	coconut shell molds used for dye cake; netted fiber bag to store shell molds; coconut water base used to rinse fabrics before dyeing; grated coconut meat rubbed on dyed fabric to produce sheen; coconut oil base for perfume; spathe ash added to lime in making cement
agriculture	coconut a major crop, many varieties recognized; copra provides cash income
hunting and fishing	half coconut shell containing bait used in bird snare; leaflet midrib used in making crab snares; coconut cloth used to wrap fish poison; coconut leaf sweeps used to drive fish into weirs and nets; dried leaf torches used in night spear fishing and harpooning sea turtles; leaflet used to tie knots as part of divination in turtle fishing; coconut water drunk as part of ritual before bonito fishing; leaflet midribs used to make fishing kite; dried midrib leaflet made into netting needle; ivory nut palm leaf midrib used as net mesh gauge; coconut fiber lines to catch sea turtles; dry coconut meat gratings tossed in water to attract fish

Material Culture Category	**Uses of coconut *(Cocos nucifera),* except as noted**
food and stimulants	coconut cream used extensively in cooking; coconut meat gratings burned in smudge fire to repel mosquitoes; dry husk or shredded leaf base fiber used a tinder; half coconut shells used in food preparation and as drinking cups; fresh coconut water as beverage; sweet and fermented toddy from palm sap
housing	leaf matting and fronts used for walls on temporary shelters; ivory nut palm leaves made into thatch sheets for roofing; coconut frond midrib strips are used to tie ivory nut palm leaves to binding rods; fiber cord used to tie thatch sheets to rafters; fiber ropes used in pole-and-sling operation to carry large house timbers; palm fronds used to cover earthen house floors; coconut shell flask of perfume kept in storage box to impart sweet scent to clothing
canoes	fiber cord used to attach and decorate end pieces and attach outrigger booms; young leaflets are strung on coconut fiber cord around outside of gunwales of large paddling canoes for decoration; shell halves used for bailing
clothing	plaited coconut fiber used to make reef shoes
ornaments	coconut shell made into small beads to decorate belts, bands and to make necklaces and pendants; burning spathe applied to sea turtle shell to loosen shell; turtle shell softened by boiling in mixture of coconut milk and sea water; coconut shell pieces used for ear piercing and made into ear rings; shell used in making comb handles; palm leaf midrib used to apply pigment in tattooing; glowing end of coconut leaflet midrib used in scarification
weapons	coconut wood used to make spears; fiber cord to make slings
recreation objects	coconut meat used to close end of nose flute

Source: LeBar, 1964.

Palm Domestication

A final perspective on the historical palm use can be realized through examination of the subject of palm domestication. Domestication of a particular palm species represents the end-point of a continuum that begins with utilization of wild palms (Clement, 1992). Over time, utilization leads to some level of management of wild populations; in turn this can result in the palm being brought into cultivation. At the point where cultivation begins, true selection also is assumed to begin for the cultivator will gather for propagation fruit or suckers from plants which have certain desirable qualities such as rapid growth, large fruit size or the like. Over many plant generations cultivated palms will come to exhibit morphological and genetic characters markedly different from their wild relatives; they are then deemed to be domesticated.

Five well-known palm species are clearly domesticated and all are currently major economic species: betel nut palm (*Areca catechu*), coconut palm (*Cocos nucifera*), date palm (*Phoenix dactylifera*), African oil palm (*Elaeis guineensis*) and pejibaye or peach palm (*Bactris gasipaes* var. *gasipaes*).

An unusual example of a noncommercial domesticated palm is the coco cumbé palm (*Parajubaea cocoides*) of South America. It is known only as an ornamental tree in Andean cities and towns of Ecuador and Colombia. Moraes and Henderson (1990) postulate that coco cumbé probably originated from the wild *P. torallyi* which is endemic to Bolivia.

On the path to domestication is the aguaje palm (*Mauritia flexuosa*) of the Amazon Region (Delgado *et al*., 2007).

The palm domestication process is driven by an economic interest in one key product, as is generally the case in plant domestication. The principal product is in some instances mutually exclusive to another palm use; in other instances the predominance of the key economic product may overshadow other useful products of the same palm and preclude development of the palm in a more integrated fashion. This situation can be remedied by promoting greater understanding of the inherent multipurpose character of already-domesticated palms as well as those with domestication potential. For present purposes, it is useful to review the domestication of the five major palms and their multipurpose character.

Betel Nut Palm (Areca catechu)

This palm appears to have been domesticated for its hard dried endosperm which contains the alkaloid arecoline and is chewed as a mild narcotic. Similar to the chewing of tobacco, betel nut use poses serious health problems. Betel nut has a number of reported medicinal uses. The origin of the betel nut palm is unclear because of its long history of use, the fact that a definitely wild population has never been found and that it is but one of about 47 species distributed in South and Southeast Asia and the Pacific. In India it has been in cultivation for as many as 3,000 years, but is considered to have been introduced from Southeast Asia at an earlier time (Bavappa *et al*., 1982).

India is the leading world producer of betel nut; in 2003 there were some 290,000 ha under cultivation on plantations and small farms with production amounting to 330,000 t (http://www.plantcultures.org/plants/betelnut_production__trade.html). Bavappa *et al.* (1982), in the most comprehensive study of this palm, devoted a chapter to alternative uses of betel nut. The endosperm contains tannin obtained as a by-product of preparing immature nuts for chewing and also fat comparable to coconut oil (see Table 9-1). Currently in India the husk is used as fuel or mulch although it is a source of fiber material suitable for hard board, paper board and pulp for paper. Leaf sheaths have traditional uses to make containers and represent a raw material with industrial applications to manufacture plyboard as well as disposable cups and plates. Betel nut palm leaves are used for thatch and organic manure and the stem wood made into a variety of articles such as waste paper baskets. The palm heart is the only food product from this palm.

Additional technical information on the betel nut palm can be found in a 1982 symposium proceeding (Shama Bhat and Radhakrishnan Nair, 1985). An extensive bibliography on the subject has also been published (Joshi and Ramachandra Reddy, 1982).

Coconut Palm (Cocos nucifera)

This is the most ubiquitous palm of tropical coastal areas and a species with which nearly everyone is familiar. Origin of the coconut has long been a matter of debate; some evidence (Schuiling and Harries, 1994) suggests that the coconut originated in Malesia (the region between Southeast Asia and Australasia), where wild types have been found. New DNA research results trace the origins of *Cocos* to the Oligocene (ca. 37 MYBP) in Eastern Brazil, with its divergence from Syagrus at about 35 MYBP. This new evidence of the phylogenetic history of the coconut should not be confused with the very much more recent domestication of the palm (Meerow, *et al*., 2009).

Domesticated coconuts were dispersed by humans and by ocean currents, for the nut will float and remain viable for three months or more. The chief criterion used in selecting coconuts for cultivation appears to have been larger nuts with a greater quantity of useable endosperm (coconut meat). A secondary factor may have been more rapid germination. Exactly when and where the coconut first was domesticated is a difficult question to answer. Child (1964) cites evidence that coconuts were in India some 3,000 years ago but may, like the betel nut palm, have been introduced.

The coconut is often referred to as the "tree of life" because of its multitude of subsistence and commercial uses (Ohler, 1984; Persley, 1992). Figure 2-1 attempts to capture the remarkable utility of the coconut palm[3]. Table 9-10 through Table 9-14 provide technical information on the major coconut products.

FAOSTAT production data for 2007 show that Indonesia, Philippines and India are the world's leading producers of coconuts; together they account for about 75 percent of world production. The coconut's primary commercial product is edible oil, derived from the endosperm, which is one of the world's most important vegetable oils. The Philippines is the largest producer of copra and coconut oil. In 2006 the Philippines provided just over 50 percent of world coconut oil exports. Coconut is grown under plantation conditions but remains an important tree crop of the small farmer who often cultivates the palm in combination with other annual and perennial crops, and with livestock raising.

A new development plan in the Philippines to plant up to 400,000 ha of coconuts to produce biofuel for diesel cars could have a large impact on the coconut industry in Southeast Asia. The project was announced in June 2009 by Pacific Bio-Fields Corporation of Japan and would utilize abandoned agricultural land in northern Luzon. A portion of the biofuel produced would be exported to Japan www.reuters.com/article/GCA.../idUSTRE55H1WJ20090618).

Numerous other studies on coconut have been published. A selection of technical information sources includes the proceedings of two international symposia (Nayar, 1983; Nair *et al*., 1993); a lengthy monograph (Menon and Pandalai, 1958); a technical guide written for small landholders (Bourgoing, 1991); a study of the combining of cattle raising and coconut growing (Reynolds, 1988); an edited volume on modern coconut management (Ohler, 1999); a comprehensive new study of coconut cultivation and coconut products (NIIR, 2008) and an examination of coconut polyculture (Rethinam and Sivaraman, 2008). Information about world markets for coconut oil, coconut meat and husk fiber (coir) is available in a series of studies (see: Chapter 11, Additional Information Sources).

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[3] A number of other palms could similarly be represented as "trees of life," among them are the date palm, African oil palm, palmyra palm, babaçu palm and pejibaye palm.

Date Palm (Phoenix dactylifera)

This may represent the oldest domesticated palm, having originated most likely in Mesopotamia (modern Iraq) 5,000 to 10,000 years ago. The earlier time period would place the date palm among the most ancient of domesticated plants. Recent research on the date palm's origins reveal that the cultivated form is closely related to wild and feral date palms in the Near East, Middle East and North Africa, and that they are considered to be the same species (Zohary and Hopf, 2000).

In cultivation there exist numerous date varieties named for the fruit characteristics. Nutritional data on one of the date varieties is provided in Table 9-26. The date palm is also a multipurpose species, greatly relied upon for an array of products in its desert environments of limited vegetation resources (Dowson, 1982; Barreveld, 1993). The three leading date-producing countries in 2007 were Egypt, Iran and Saudi Arabia; combined they represented 46 percent of world production (FAOSTAT).

Other sources of technical information on the date palm include the following. Dowson and Aten (1962) describe date processing in detail; Munier (1973) wrote a general study of the palm; a lengthy bibliography of date palm was compiled by Asif and Al-Ghamdi (1986) and there have been published proceedings of two recent international conferences on date palm held in Abu Dhabi (ECSSR, 2003; Zaid *et al*., 2007). The current standard reference on all aspects of date cultivation is by Zaid (2002).

Figure 2-1 ***The coconut palm (Cocos nucifera); the tree of life. Examples of end-products, clockwise. Trunk - construction, wood, timber, plywood, furniture, picture frames, charcoal. Leaf Sheath - bags, hats, caps, slippers. Sap - toddy, arrak, vinegar, yeast. Meat -oil, desiccated coconut, copra cake, candy, coconut water, coconut cheese, coconut milk, jam. Heart - fresh and pickled palm heart, animal feed. Leaves - mats, hats, slippers, midrib brooms, draperies, bags, toothpicks, roof thatch, midrib furniture, fencing, fans, fuel, fodder. Shell - trays, buttons, jewelry, trinkets, charcoal, activated charcoal, wood preservative, bowls, fuel. Coirdust - coirdust coke, plasterboard, blocks, insulation, potting mix. Husk - rope, yarn, coir mat, coir fiber, brushes, cushion and mattress stuffing, compost, fuel. Roots - dyestuff, medicine, fuel.***

African Oil Palm (Elaeis guineensis)

The African oil palm represents the most recently domesticated major palm. Within the past century this palm was brought into formal cultivation and developed to increase its mesocarp oil productivity through breeding of high-yielding hybrids. The oil palm is unsurpassed in yield of oil per unit area (Corley and Tinker, 2003). Unlike the three preceding examples, this palm exists in wild, semi-wild and cultivated states in West Africa where it originates, and also in Madagascar and East Africa. It is likewise cultivated extensively in Southeast Asia and to some degree in the New World tropics.

In 2007, Malaysia was the leading nation in production of this vegetable oil, closely followed by Indonesia; these two countries accounted for over 80 percent of world oil palm fruit production (FAOSTAT). More studies have been published on the African oil palm than any other single palm. A sampling of titles includes: an economic study (Moll, 1987); a volume on research (Corley *et al*., 1976); a general book on the palm (Surre and Ziller, 1963); and an example of one of several conference proceedings from Malaysia (Pusparajah and Chew Poh Soon, 1982). Corley and Tinker (2003) have produced the standard reference on all aspects of oil palm. Information about world markets for African oil palm as well as babassu can be found in a series of studies (see: Chapter 11, Additional Information Sources).

Apart from being an outstanding plantation crop, the oil palm remains a multipurpose tree among local populations in Africa. It is a traditional source of cooking oil, palm wine and other useful products. Nutritional data on the fruit and oil are given in Table 9-17 and Table 9-18. The African oil palm has potential for multipurpose utilization within the same areas where it is grown on plantations.

Pejibaye (Bactris gasipaes var. gasipaes)

The only example of a major domesticated palm from the American tropics is the pejibaye. Pejibaye may have originated from a wild relative or relatives (*Bactris gaspiaes* var. *chichagui* is closely related, and has similar but smaller fruits) possibly as a hybrid, in the southwestern portion of the Amazon Basin and has been widely dispersed by humans in South and Central America (Clement, 1988; Mora-Urpí, 1996). The palm was domesticated for either its mesocarp starch or oil; both mesocarp and endosperm are edible after being boiled. Table 9-2 and Table 9-3 provide nutritional information on the fruit. The palm produces basal suckers that can be separated for propagation, or it can be grown from seed. Pejibaye has been under cultivation since ancient times in humid tropical areas at elevations from sea level to about 1,200 m.

Pre-Columbian uses of pejibaye were documented by Patiño (1963). In addition to the food uses already mentioned, the palm heart is eaten; the mesocarp pulp is fermented into an alcoholic beverage (chicha); male flowers are used as an ingredient in flavorings; leaves are employed for thatching and basketry; spines are made into needles; stem wood is cut to fashion bows, arrows, fishing poles, harpoons as well as flooring and paneling for houses; the roots have medicinal use as a vermicide.

Pejibaye has been the object of considerable development in Central and South America focused on improving fruit quality for human and animal consumption; it is also under cultivation as a commercial source of palm hearts. An international conference on the

biology, agronomy and industrialization of pejibaye was held in 1991 in Peru (Mora-Urpí *et al.*, 1993). Mora-Urpí *et al*., (1997) and Mora Urpí and Gainza, (1998) are two excellent sources of information on this palm. Costa Rica is said to be the leading country in pejibaye cultivation, but data on area and production levels are lacking. To date, pejibaye has not been cultivated commercially outside the Americas.